CENTER OF PLANNING AND ECONOMIC RESEARCH

LECTURE SERIES

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By

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ATHENS 1977

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A DISEQUILIBRIUM THEORETICAL APPROACH TO THE PROBLEMS OF INFLATION AND UNEMPLOYMENT

By

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ATHENS 1977

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CENTER OF PLANNING AND ECONOMIC RESEARCH

The Center of Planning and Economic Research (KEPE) was founded in 1961 as an autonomous public organisation, under the title "Center of Economic Research", its basic objective being research into the problems of the operation, structure and development of the Greek economy. Another of its objectives was the training of young Greek economists in modern methods of economic analysis and research. For the establishment and operation of the Center considerable financial aid was provided by foreign foundations.

During 1964, the Center of Economic Research was reorganised into its present form, as the Center of Planning and Economic Research. In addition to its function as a Research and Training Institute, the Center, in its new form, was assigned the following tasks by the State: (1) The preparation of economic development plans at a national and regional level, (2) the evaluation of public investment programmes and, (3) the study of short-term developments in the Greek economy and advising on current problems of economic policy.

For the realisation of these aims, the KEPE, during its first years of operation (1961-1966) collaborated with foreign scientists and foundations. The latter helped in

the selection of foreign economists who joined the Center to carry out scientific research into the problems of the Greek economy and in the organisation of an exchange programme, including the post-graduate training of young Greek economists at universities abroad.

The Center has also developed a broad programme of scholarships for post-graduate studies in economics. Thus, in collaboration with foreign universities and international organisations, a number of young economists from Greece are sent abroad each year, to specialise in the various fields of economics. In addition, the KEPE organises a series of training seminars and lectures, frequently given by distinguished foreign scholars invited for that purpose to Greece.

In addition to the above, the KEPE maintains contact with similar institutions abroad, and exchanges publications and information concerning developments in methods of economic research, thus contributing to the promotion of the science of economics in the country.

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FOREWORD

This essay is based on a text prepared for a lecture I gave at the Center of Planning and Economic Research in November 1975. In the twelve months that elapsed up to the writing of this final draft, I had the opportunity of discussing this and other closely related theoretical matters with many of my colleagues and graduate students, and I wish to thank them all for their comments. Finally, I wish to thank the Director of the Center, Mr. Evangelos Voloudakis for extending his invitation to me to deliver this lecture.

PANAYOTIS G. KORLIRAS

Pittsburgh
November 9, 1976

1. WALRASIAN AND NON-WALRASIAN MACROECONOMIC THEORY

Macroeconomic theory, like almost all of economic theory, has for a rather long time been dominated by what is generally called "neoclassical economics". This label covers a wide range of doctrinal and analytical approaches, and it is not easy to pinpoint any particular economist or even school of thought as being "the" representative neoclassical. There are, however, two principal theoretical traditions which, still in our own days, provide the basic conceptual framework of analysis: first, the work of Alfred Marshall for microeconomic theory, and second, the work of Léon Walras for general equilibrium theory. Modern macroeconomics had its genesis in the work of John Maynard Keynes, published some forty years ago, and from its beginning modern macroeconomics was, as it still is, in revolt against the postulates of what Keynes called "classical" theory, and what today we would rather more appropriately call "neoclassical" theory. It is one of the most astonishing phenomena in the history of a science to observe that although Keynesian theory had a profound impact, especially in practical policy

matters, and it became the official orthodox view on economic policy over most of the western industrial world, neoclassical theory continued to flourish and dominate the domain of academic and pure theory over the decades following the publication of the "General Theory". Due in part to Keynes' own fervour in proposing something radically new, without paying too much attention on its detailed theoretical foundations, there was and still exists considerable disagreement among economists as to what was the fundamental message of the Keynesian Revolution.

Insofar as Keynesian economics was supposed to prove the possibility of an under-employment macroeconomic equilibrium in the absence of active governmental stabilisation policy, the post-Keynesian macroeconomic theory succeeded in convincing the pure theorists that Keynesian theory is nothing but a special case of a wider class of postulates and models which maintain almost intact the fundamental aspects of the neoclassical tradition. And although Keynes was always considered to be faithful with the grand-father of the Cambridge tradition, i.e. Marshall, the heresy contained in the "General Theory" was accurately felt to be directed against the general equilibrium approach of Walras. The work of Walras, and especially his "Eléments d'Economie Politique Pure", is distinguished for its abstract thought and

the elegant schematisation of the working of the economy in a system of simultaneous equations, where the economic units or agents are permitted to engage in production and exchange only at a price vector which guarantees an economy-wide mutually consistent market-clearance. Such a general equilibrium, which does not permit any under-utilisation of the resources, is brought about by the working of the impersonal market forces. As a matter of fact, Léon Walras used the fictional character of the "auctioneer" in order to personalise Adam Smith's "invisible hand", where the omnipotent and omniscient auctioneer is capable, through a process of "tâtonnement", of determining this general equilibrium price vector. At such a general equilibrium position, the system is *ex hypothesi* in harmony, in fact at a socially optimum arrangement with any given initial distribution of income and wealth. Carried over to macroeconomic theory, the Walrasian approach implied that in a full-employment economy, flexibility in the price level and money wages is sufficient to prove the existence and attainment of a full-employment equilibrium. The culmination of post-Keynesian neoclassical macroeconomics is the seminal treatise by Don Patinkin "Money, Interest, and Prices" (15), and the implications of his analysis seem to be the antithesis of whatever was radically new or provocative in the work of Keynes.

The Walrasian general equilibrium approach is still very much alive in academic economics, and responsible for a large number of works in the area of mathematical economics. It has many critics but also many supporters, who think that it provides a useful comprehensive framework of analysis rather than a set of definite results and implications (6). For macroeconomic theory, however, it has some undesirable features. On the one hand, it contradicts the obvious experience about instability and under-utilisation of resources. On the other hand, it reaches foregone conclusions which are included in the premises of the example. What would happen if there were no tâtonnement, if the agents were actively involved in production and exchange even at "false" prices, i.e. non-market -clearance price vector? In this case, unless the plans of the agents are all mutually consistent, the adjustments taking place within the system will not be only "price adjustments" but also "quantity adjustments". Then, if employment and income are no longer by assumption fixed at their full-employment level, they become endogenous variables. It was once thought that such "income effects" are unimportant and that their consideration should not preclude us from working in a Walrasian framework (8). If we accept that position, then we can also accept the à la Patinkin neoclassical or Walrasian reformulation of Keynesian theory.

The aforementioned problem in the logical foundations of the Walrasian approach was first pointed out by Nicholas Kaldor (10) in his distinction between the endogenous adjustment mechanisms, which may lead towards equilibrium, and the conditions which define the position and character of such an equilibrium. The *ceteris paribus* assumption, so common in micro-economic analyses, is indeed needed to bypass this problem, and such an expediency gives it its ultimate justification as an analytical aproach or methodology. In macroeconomic theory, however, since a particular value of income is the condition defining the full-employment equilibrium, we have the following problem: In the more realistic non-Walrasian non-tâtonnement framework, if income is itself an endogenous variable, the conditions which define the equilibrium cannot be taken as given. This *ceteris paribus* assumption is no longer valid, and then it is not obvious that the endogenous price-cum-quantity adjustments will lead to the attainment of a full-employment macro-equilibrium. Then, full-employment is just a special case of a wider class of feasible macro-equilibria, which is exactly what Keynes was trying to convince us about in his "General Theory". An endogenously determined and variable level of income and employment is the core of the Keynesian "Principle of Effective Demand", and to ignore that cru-

cial element in macroeconomics is, to use a metaphor borrowed from a comment by Takashi Negishi, like "Hamlet without a prince in it".

During the past ten years there has been a considerable activity in reinterpreting the Keynesian doctrine along lines different from the Walrasian neoclassical synthesis (2, 3, 4, 9, 13, 14, 17). The basic tenet of these "revisionist" interpretations is eloquently given by G. Shackle: "The fatal defect (of neoclassical theory) was its assumption that men possess adequate knowledge, that they can act in the light of reason fully supplied with its necessary data. But this assumption is contrary to all experience... Unemployment is due to men's failure to secure, in good time, knowledge of each others' conditional intentions or potential reactions... Unemployment is the consequence of reflection and of disorder. A theory of unemployment is, necessarily, inescapably, a theory of disorder" (17, pp. 136, 140-141, 133). The so-called "Keynesian Counter-Revolution" along these lines, was formalised in the seminal paper by R. W. Clower (2), and it was the focal point in the distinction between "Keynesian Economics" (i.e. neoclassical synthesis) and the "Economics of Keynes" elaborated and documented in the work by Axel Leijonhufvud (13). The fundamental point was what Clower called the "dual decision hypothesis", which amounts to this: In situations

of disequilibrium, a consumer's realised expenditure will be different from his intended expenditure to the extent that his realised income from labour employment is different from his expected employment and income. In a non-Walrasian world, where production and exchanges are taking place even at a non-market-clearance price vector, an excess supply in the labour market will correspond to an excess supply in the commodities or output market, since effective aggregate demand is determined and constrained by actual employment and actual (effective) aggregate income. This seems to be the true meaning of Keynes' consumption function. Thus, "effective" excess demands may be non-zero in all markets, while the "notional" excess demands (i.e. those corresponding to the full *a priori* knowledge of the general equilibrium price vector) are zero only in a neoclassical schema (2, 12).

In a non-Walrasian framework, situations of non-zero excess demands will generate not only "price-adjustments" but also "quantity-adjustments", because employment and income are no longer given at their full-employment values. The implication of the "dual decision hypothesis" and the absence of the Walrasian auctioneer is that the interplay of the price-cum-quantity adjustments will not necessarily lead to a neoclassical full-employment general equilibrium, but they

may instead lead to what Bent Hansen has called a "quasi-equilibrium" (7). A quasi-equilibrium is defined as a situation where although the relative prices are determined, the system is not in equilibrium in the traditional sense. The excess demands are not zero, and the absolute prices are continuously rising or falling. To paraphrase Bent Hansen's own words, in a quasi-equilibrium, the forces at work on the relative prices do cancel each other out, whereas those at work on the absolute prices do not. To explain, therefore, the Keynesian proposition of an "unemployment equilibrium" one must pursue the matter on the basis of a non-Walrasian methodology, and of a system capable of having quasi-equilibria. This is the essence of the "disequilibrium macroeconomics", as it has been presented in the general macro-models developed in the last few years (1, 11, 18) which seek to explain the existence and persistence of such phenomena of disorder like unemployment and inflation (i.e. situations of disequilibrium, non -zero excess demands) rather than reduce the actuality of these phenomena to mere exceptional and transitory aspects of an otherwise assumed economy devoid of disorder.

The following sections of the present essay present the essentials of a simplified disequilibrium macroeconomic model, with particular attention paid to the methodology of this new approach.

In this instance, to understand the methodology of a still evolving macroeconomic theoretical framework is absolutely essential in grasping its substantive message and conclusions.

2. THE ELEMENTS OF A SHORT-RUN MODEL

What follows is the outline of a simple theoretical model in which the persistence of unemployment and inflation is explained by the possibility of the existence of quasi-equilibria. A general disequilibrium macroeconomic model will necessarily be quite a complicated one, because it involves numerous simultaneous adjustment mechanisms. For this reason, it can either be presented by a simulation model or by a theoretical model where the adjustments are artificially decomposed into separate "stages" in order to analytically bypass the prohibitive algebraic complications of the simultaneity of events. Needless to say, this technique, recently brought into prominence by Solow and Stiglitz (18), does not deny the simultaneity of adjustment mechanisms, but it is instead a modern version of the old "period analysis" methodology. The simple model examined here abstracts from any consideration of the economy's financial sector, as a more general model was earlier developed by the author (11), but instead we here concentrate in a two-market model, focusing on the bare elements of a circu-

lar-flow-of-income schema which stresses the interplay between the output and labour markets. Our particular analytical strategy consists of distinguishing three time periods or "stages". First, the Momentary Situation (MS): it defines an infinitesimally short time period during which all "prices" are given. On the basis of these prices the plans of all the agents are formulated. If at these prices there correspond non-zero excess demands, the actual "quantities" transacted in each market will be determined by some rule. Such non-zero excess demands will generate adjustments, i.e. price changes, at the transition from one MS to another, so that at the beginning of the new MS a new set of prices will be given to the agent, and the plans will be reformulated accordingly. Second, the Short-Run (SR): it is defined as the time sequence of MS's, but it is sufficiently short so that we ignore the effects of capital accumulation and population growth. During the SR, the "price adjustments" play the principal rôle, while the corresponding "quantity adjustments" are merely derived from the price adjustments. The SR equilibrium will be attained when these adjustments stop, which happens when the market forces responsible for them are neutralised. This SR equilibrium will either be a full-equilibrium if all markets are cleared, or a quasi-equilibrium if not all markets are cleared but nothing changes the

situation at the same time. Third, the Long-Run (LR): it is defined as the time sequence of SR full— or quasi-equilibria. From one SR equilibrium to another we take into account the effects of capital accumulation and population growth, as factors which cause shifts in the supply and demand schedules in the (output and labour) markets. The zero or non-zero excess demands in each market, as determined in the SR equilibria, will now be conditioned by these LR effects, as the latter are summarised by two critical ratios: the employment-capital ratio (ε) which determines the output-capital ratio (y), and the labour supply-capital ratio (v). The LR equilibrium is a steady-state determining (ε,v), and thus the steady-state output per head and the steady-state rate of unemployment ($u = v - \varepsilon$).

During any MS situation, we assume that the actual labour employment (N^e) is determined as the minimum of the demand for labour (N^d) and the supply of labour (N^s), as

$$N^e = \min (N^s, N^d) \qquad (1)$$

From this homogeneous labour input, and with a constant capital input, there is produced a homogeneous output (Q) which is also perishable (to avoid the complication of stocks and inventories). We use a simple production function as

$$Q^s = F(N^e),\ F' > 0,\ F'' < 0 \qquad (2)$$

The labour supply and demand schedules are defined in terms of the real wage rate ($w = W/P$) as

$$N^d = h(w) \qquad h' \leqslant 0 \qquad (3)$$

$$N^s = j(w) \qquad j' \geqslant 0 \qquad (4)$$

while we assume that there exists a positive w_f such that $h(w_f) = j(w_f)$. We thus have, from equations (1)-(4), that

$$Q^s = F[\min\ (N^s, N^d)] = f(w) \qquad (5)$$

where $f'(w) \gtrless 0$ and $f''(w) \lesseqgtr 0$, as $w \lesseqgtr w_f$.

The symbol w thus denotes the real wage assumed to be given at the beginning of each MS, because the money wage (W) and the price level (P) are assumed given. As a result, equation (5) is the aggregate supply function of output, based on the profit maximization behaviour of the firms.

The aggregate demand for output (Q^d) consists of the demand for consumption (C), and the exogenous or autonomous elements of aggregate expenditure (A). The former depends upon disposable income (Q_{di}), while the latter consist of pri-

vate investment, government (fiscal) expenditures, and the net balance of trade.

$$Q^d = C + A \tag{6}$$

We use a linear consumption function:

$$C = (1 - s)\, Q_{di} \tag{7}$$

where s is a constant marginal propensity to save. Disposable income has two components: realised labour income (wN^e) and realised profits of the firms (Z). Real profits are determined by

$$Z = Q^* - wN^e \tag{8}$$

where Q^* is the realised volume of output sales at the price vector given in each MS, determined by

$$Q^* = \min(Q^d, Q^s) \tag{9}$$

$$\text{Thus} \quad Q_{di} = wN^e + Z = wN^e + (Q^* - wN^e) = Q^* = \min(Q^d, Q^s) \tag{10}$$

$$\text{and} \quad Q^d = C + A = (1 - s)\,[\min(Q^d, Q^s)] + A \tag{11}$$

We then have the following cases:

$$\text{if } Q^d < Q^s,\ Q^d = (1-s)Q^d + A \text{ or } Q^d = \frac{A}{S} \quad (12)$$

$$\text{if } \quad Q^s < Q^d,\ Q^d = (1-s)\ Q^s + A = (1-s)\ [f(w)] + A = \Phi(w;A) \quad (13)$$

$$\Phi_w \gtrless 0 \text{ and } \Phi_{ww} \lesseqgtr 0 \text{ as } w \gtrless w_f$$

The autonomous elements of aggregate expenditures impose an upper bound on Q^d at any price vector in situations of excess demand for output. Thus, the simple Keynesian multiplier equation is, in our context, a special case, so that

$$\max Q^d = \frac{A}{S}$$

Figure 1 shows one possible state of the output market at a given A. In any MS, a given w will correspond to zero or non-zero excess demands in the labour (E_N) and output (E_Q) markets according to

$$E_Q \gtreqless 0 \quad \text{as} \quad w_1 \gtreqless w \gtreqless w_2$$

$$E_N \lesseqgtr 0 \quad \text{as} \quad w \lesseqgtr w_f$$

In terms of Figure 1 it is obvious that neither w_1 nor w_2 correspond to an SR equilibrium, and we now introduce the dynamic "price adjustments" such that

$$\hat{W} = k_1 \cdot E_N(w) \tag{14}$$

$$\hat{P} = k_2 \cdot E_Q(w;A) \tag{15}$$

where the hats indicate percentage changes, and k_1 and k_2 are the speeds of "price variables adjustment" in each market. Even, however, at the given A there exist several possible positions of SR equilibrium, depending on the relative numerical values of k_1 and k_2 (assuming that both are finite and positive), since at the given A, we have $E_Q(w_f;A) < 0$ while $E_N(w_f) = 0$. Figure 2 shows one of the many possibilities. A SR equilibrium occurs when

$$\hat{w} = \hat{W} - \hat{P} = 0 \tag{16}$$

and it corresponds to a real wage rate such that

$$k_1 \cdot E_N(w_E) = k_2 \cdot E_Q(w_E;A) \tag{17}$$

In Figure 2 we have $w_f < w_E < w_2$, and careful inspection will indicate that at w_E the system is a stable quasi-equilibrium with permanent excess

supply situation in both the labour and the output market. This is the core of the sort of "under-employment equilibrium" which is so often mentioned in simple textbook expositions of the Keynesian macroeconomics. In fact, such a model is directly comparable to more "classical" theoretical constructs, where it can be seen that similar quasi-equilibria are not admissible in the classical theory (12). Finally, the importance of the autonomous elements in aggregate expenditure (notably investment and government expenditures) can be shown in the example of Figure 3. In that diagram, we postulate a value of A so high that there corresponds a positive E_Q at any real wage. In this case we can only indicate the possibility of an unstable quasi-equilibrium at some $w_E < w_f$ involving positive excess demands in both markets, i.e. involving both inflation and less than maximum labour employment.

It is easy to generalise the implications of such a non-Walrasian simple aggregative model, and then formally analyse the questions of existence, uniqueness and stability of macroeconomic quasi-equilibria, with or without a financial sector (1, 11, 12). One final comment must however be made: any quasi-equilibrium, with either positive or negative excess demands in both markets, will be such that the actual level of labour employment will be smaller than the employment level implied

by $h(w_t) = j(w_t) = \max N^e$, and likewise actual output will fall short of its feasible maximum. A quasi-equilibrium, whether inflationary, is necessarily associated with under-utilisation of the economy's productive capacity. A quasi-equilibrium is, upon deeper inspection, a "disequilibrium" situation characterised by "disorder".

3. ANALYSIS OF THE STEADY-STATE

The long-run analysis takes the sequence of short-run full — or quasi-equilibria, as these are affected by capital accumulation and population growth. The short-run price-adjustments, and the derived quantity adjustments, were determined on the basis of given supply and demand schedules in the two markets. Whatever the nature of the SR equilibrium may be, in the long-run analysis a different set of price and quantity adjustments will be generated as these schedules (and their points of intersection) shift due to capital accumulation and population growth. Being, therefore, interested in the steady-state or LR equilibrium of a growing economy we must re-write the production function as

$$Q = F(N^e, K) \qquad (18)$$

where K is the capital stock, now a variable but previously assumed as constant in the short-run analysis. It facilitates the algebra if we postulate that the production function (18) is linear homogeneous with respect to both inputs, so that it can

alternatively be expressed in its intensive form as

$$y = f(\varepsilon) \quad f'(\varepsilon) > 0, \; f''(\varepsilon) < 0 \qquad (19)$$

where y is Q/K, the output-capital ratio, and ε is N^e/K, the labour employment-capital ratio. This latter ratio is the per unit of capital stock desired level of labour input from the part of the firms, and it is determined by the profit maximizing condition

$$f'(\varepsilon) = \frac{W}{P} \qquad (20)$$

Obviously, condition (20) is satisfied only when there is either zero or negative excess demand in the labour market. But even if there is a positive excess demand for labour and (20) is not exactly satisfied, this condition will again give us the desired or planned labour employment-capital ratio, which is here taken to be the source of pressure for dynamic adjustments in this market. Thus, condition (20) regardless of whether or not it is exactly satisfied, will imply that the firms' desired ε will change according to the following dynamic version of equation (20), i.e.:

$$\hat{\varepsilon} = A(\hat{P} - \hat{W}) \qquad (21)$$

where A is a positive factor whose numerical val-

ue depends, other things, upon the elasticity of the marginal product of labour.

In the absence of inflationary expectations, output prices and money wages will change depending on the value of excess demand in the output and labour markets, respectively. But in the long-run the state of excess demands is influenced by capital accumulation and population growth. Population growth is assumed to proceed at an exogenously given annual rate (n), and it affects the availability of labour inputs in the succession of SR equilibria. Capital accumulation affects several things: the productivity of employed labour, the available or potential output per head, and thus indirectly the productivity of capital and the firms' desired labour employment per unit of capital. We now postulate that in any sequence of SR equilibria

$$\hat{P} = \alpha\left(\frac{I}{K} - \frac{S}{K}\right) \quad \alpha > 0 \qquad (22)$$

and the difference between planned investment and savings per unit of capital measures the extent of excess demand in the output market, causing an output-prices adjustment at a speed equal to the constant positive α. We then generalise our saving (and consumption) function, by continuing to assume that S/K depends upon income, as

$$\frac{S}{K} = s(\varepsilon) \quad s'(\varepsilon) > 0 \qquad (23)$$

In the case of positive excess demand in the labour market, equation (23) means that planned savings depend upon planned output, or income. Although this restriction in the interpretation of (23) does not hold under alternative circumstances, even when this restriction applies the interpretation of the variables used and of the model itself is not seriously affected; in fact, the reader can easily verify by himself that the inflationary impact of the excess demand case will only be made stronger if we were to correct this restriction, so that the qualitative character of our conclusions would not be damaged or improved. For the same reason, we use the same ε for the computation of the marginal productivity of capital (r), according to the formula

$$r = f(\varepsilon) - \varepsilon \cdot f'(\varepsilon) = r(\varepsilon) \text{ with } r'(\varepsilon) > 0 \qquad (24)$$

Using the above expression we state that planned invetsment is a positive function of the difference between the marginal productivity of capital and the rate of interest (m). In line with our previous assumption about the exogeneity of investment in the SR analysis, we take the rate of interest to be under complete control by the monetary author-

ities, a sort of exogenously given parametric-shift factor affecting the entire "marginal efficiency of investment" schedule. Thus,

$$\frac{I}{K} = i\,[r(\varepsilon);m] = i(\varepsilon;m) \qquad (25)$$

with $i'(\varepsilon)>0$. Then, by substituting equations (23) and (25) into equation (22) we get

$$\hat{P} = \alpha\,[i(\varepsilon;m) - s(\varepsilon)] \qquad (26)$$

For the labour market, we have that in the absence of inflationary expectations, money wages change in response to excess demand in the labour market. For our LR analysis, we assume that the excess demand for labour in a succession of SR equilibria is measured by the divergence between the (desired or actual) labour employment and the availability of potential labour supply (N) per unit of capital, so that

$$\hat{W} = j\left(\frac{N^e - N}{K}\right) = j(\varepsilon - v) \qquad (27)$$

where $v = N/K$, the available labour-capital ratio, at any time period. Equation (27) implies that money wages vary inversely with the unemploy-

ment rate per unit of capital. Furthermore, it is convenient to linearise the above expression as

$$\hat{W}=j_1(\varepsilon)+j_2(v) \text{ with } j_1'(\varepsilon)>0,\ j_2'(v)<0 \quad (28)$$

Then, by substituting equations (26) and (28) into (21) we have the following fundamental relationship

$$\begin{aligned}\hat{\varepsilon} &= A\ \{\alpha[i(\varepsilon;m)-s(\varepsilon)]-j_1(\varepsilon)-j_2(v)\} \\ &= A_1(\varepsilon,v;m) \qquad (29)\end{aligned}$$

The long-run analysis is dominated by a differential equation (29) in terms of the two endogenous variables, describing the adjustments derived from an interlocking system of price and quantity adjustments, as the LR is an unfolding sequence of (W,P) determined in the successive SR equilibria, as these are affected by the processes of capital accumulation and population growth.

These last two processes are the explicit basis for the second fundamental differential equation of the LR model, which describes (v). From the definition of v we have that

$$\hat{v} = \hat{N}-\hat{K} \qquad (30)$$

and we have already fixed $\hat{N}=n$. Furthermore, to clarify the implications for the labour market, we assume a constant labour market participation ra-

tio. Then, we postulate a relationship describing the realised rate of capital accumulation ($\hat{K}$) as a linear combination of planned investment and savings, like

$$\hat{K} = \lambda \frac{I}{K} + (1-\lambda)\frac{S}{K} = \lambda \cdot i(\varepsilon;m) + (1-\lambda) \cdot s(\varepsilon) = G(\varepsilon;m) \quad (31)$$

The above expression is required since in a quasi-equilibrium planned savings and investment are not equal, so that neither of them can account for the actual rate of capital accumulation. The coefficient λ is a constant positive number, bounded between zero and one when there is excess supply, and equal to one when there is excess demand, in the output market. It is then obvious that $G'(\varepsilon) > 0$. Thus, combining equations (30) and (31) we get the second fundamental differential equation of our LR model

$$\hat{v} = n - G(\varepsilon;m) = A_2(\varepsilon,v;m) \quad (32)$$

Equations (29) and (32) taken together, are a system of differential equations describing the path of the two endogenous variables and the determination of the LR steady-state equilibrium, which is defined as

$$\hat{\varepsilon} = \hat{v} = 0 \quad (33)$$

Without discussing here the details of a proof of the existence and uniqueness of the LR equilibrium, the reader can verify the following proposition: if an LR equilibrium exists, it will also be unique. Furthermore, this LR equilibrium will be locally stable if these conditions are satisfied:

$$-Aj_2'(v) \cdot G'(\varepsilon) > 0$$
$$\alpha \cdot i'(\varepsilon) < \alpha \cdot s'(\varepsilon) + j_1'(\varepsilon) \qquad (34)$$

As the above stability conditions are not too stringent to be satisfied, the discussion that follows will presume the existence of a unique and stable long-run steady-state equilibrium, at which the two endogenous variables take their steady-state values (ε_T, v_T), such that we can define a steady-state rate of unemployment per unit of capital (u_T) given by

$$u_T = v_T - E_T \qquad (35)$$

It must be re-emphasised, at this point, that the LR equilibrium is nothing else but the convergence to a perpetuated SR full — or quasi-equilibrium. Once the system has attained such a steady-state, the characteristics of the SR equilibrium will not change during the time sequence of its repetition, unless there is a change in one of the exogenous variables (such as, e.g., the rate of interest). The

steady-state describes a sequence of invariable short-run equilibria. The question, therefore, is to examine what sort of such solutions the long-run analysis gives us, what is the nature of the LR equilibrium. And here, as it will be seen very shortly, the long-run analysis confirms our conclusions of the short-run analysis, as of course should be the case. More explicitly, the attainment of a long-run equilibrium implies that

$$\hat{\varepsilon} = 0 \text{ or } \alpha[i(\varepsilon;m) - s(\varepsilon)] = j(\varepsilon - v) \quad (36)$$

and

$$\hat{v} = 0 \text{ or } n = G(\varepsilon;m) \quad (37)$$

Depending on the steady-state values of the endogenous variables (ε_T, v_T), we see from (36) that

$$\hat{P} = \hat{W} \gtreqless 0 \text{ implies } \varepsilon_T \gtreqless v_T \text{ or } u_T \lesseqgtr 0 \quad (38)$$

This conclusion says that: if the SR equilibrium is a full-equilibrium, then the steady-state rate of unemployment is zero. If, however, the LR equilibrium is a sequence and repetition of an invariable SR quasi-equilibrium, then we shall have either positive or negative excess demands in both markets, and thus a non-zero steady-state rate of unemployment. Since u_T is, strictly speaking, non-negative, to say that u_T is "negative" would indicate those situations where price stability would

be brought about only if the planned excess demand in both the labour and output markets is eliminated, say by means of monetary and/or fiscal policy.

From the SR analysis in the previous section, we had

$$\hat{P} = \hat{W} \gtreqless 0 \text{ as } w_E \lesseqgtr w_f \text{ implying}$$
$$E_Q = E_N \gtreqless 0 \qquad (39)$$

and it is now obvious that (38) and (39) are directly connected, because the steady-state character of a perpetuated short-run equilibrium is such that

$$E_Q = E_N \gtreqless 0 \quad \text{implies} \quad u_T \lesseqgtr 0 \qquad (40)$$

Figure 4 shows the relationships expressed in (39), while Figure 5 shows the relationships in (38). The ZZ curve in Figure 5 looks like a Phillips Curve, and π_T is the steady-state rate of inflation, defined as $\pi_T = \hat{P} = \hat{W}$. The curvature of such a Phillips-type curve can be established if we postulate the non-linearity of the relationships involved, which means to know the second derivatives, as for example in

$$\hat{W} = j(\varepsilon - v) = \xi(u) \quad \xi'(u) < 0$$

with

$$|\xi'(u)| \to \begin{cases} +\infty \\ 0 \end{cases} \text{ as } u \to \begin{cases} \bar{u} \\ +\infty \end{cases}$$

where $\bar{u}$ indicates a maximum excess demand for labour or a minimum of unemployment, beyond which money wages explode upwards at an infinite speed. The curvature of the ZZ curve is, however, relatively less important than the main conclusion of the analysis: in the absence of inflationary expectations, the ZZ curve (the "Phillips Curve") must pass through the origin. What others wish to call the "natural rate of unemployment" (16) is in our model equal to zero if there are no inflationary expectations. This conclusion is in the spirit of the pure non-Walrasian macroeconomic theory, which attempts to explain such phenomena of economic disorder as unemployment and inflation as being due to unresolved disequilibria in a market-interaction framework.

4. EXPECTATIONS AND THE EQUILIBRIUM RATE OF UNEMPLOYMENT

Whether the economy will be in full-equilibrium (with price and wage stability and zero unemployment) or in quasi-equilibrium (with price and wage instability and non-zero unemployment) is, to a great extent, the responsibility of the authorities in their timely and appropriate use of the tools of economic policy, fiscal and monetary. The preceding analysis shows, however, that the economy, if left on its own, can be in disorder, that it does not necessarily tend towards the assumed order and harmony of the Walrasian general equilibrium theory. The analysis presented here is, in that sense, more "Keynesian" since it not only shows that disequilibrium or disorder is an admissible state of affairs, but it also makes a case for the application of demand-management policies. The economy may find itself at any point on the ZZ curve, but on which particular point it will be depends almost entirely on the government's economic policy, leaving room for value judgements and critical policy choices.

What complicates the matter is that there may

be inflationary or deflationary expectations, something that we have so far ignored. Such expectations are very important in determining the nature of the macro-equilibrium since they affect the behaviour of the firms and the workers (or their unions), insofar as these have sufficient market power to realise their preferred pricing preferences. That such a framework of price-makers with sufficient monopolistic market power is in sharp contrast with the simple neoclassical assumption of purely competitive price-takers with no trace of market power, is further evidence that the non-Walrasian approach is a much more realistic framework of analysing contemporary economic phenomena. In our framework we can incorporate such elements in the following simple way. On the one hand, we postulate an expected rate of money wage changes ($\hat{W}_e$), which concerns the firms and affects their pricing behaviour or policies. As a result, the output price level changes not only depending on the excess demand for output, but also if the firms expect wage increases which they pass on the price of their output, so that

$$\hat{P} = \alpha \cdot E_Q + \hat{W}_e \qquad (41)$$

On the other hand, we postulate an expected rate of price level changes ($\hat{P}_e$) which concerns the

workers and their unions. As a result, money wages change not only depending on the excess demand for labour, but also if workers expect output prices to change and effectively adjust their money wage claims accordingly. Thus

$$\hat{W} = \xi(u) + \hat{P}_e \qquad (42)$$

In effect, equations (41) and (42) introduce in our analysis the combined effects of "demand-pull" and "cost-push" elements of inflation. The nature of the steady-state LR equilibrium is now changed to

$$\alpha \cdot E_Q + \hat{W}_e = \xi(u) + \hat{P}_e \qquad (43)$$

and we denote by π_T the steady-state rate of inflation given by

$$\hat{P} = \hat{W} = \pi_T \qquad (44)$$

It is obviously useful but not really necessary to postulate any connection between $\hat{W}_e$ and $\hat{P}_e$, since the workers' expectations appear to be the dominant factor in determining the nature of the LR equilibrium. In fact, equation (43) implies that

$$\text{at } \pi_T = 0, \; u_T \gtreqless 0 \quad \text{as} \quad \hat{P}_e \gtreqless 0 \qquad (45)$$

$$\text{at } u_T = 0, \; \pi_T \gtreqless 0 \quad \text{as} \quad \hat{P}_e \gtreqless 0 \qquad (46)$$

The above results (45) and (46) imply that in the presence of non-zero inflationary expectations, the ZZ curve will not pass through the origin. More specifically, the ZZ curve will intersect the positive (negative) halves of the π_T and u_T axes if we have inflationary (deflationary) expectations, while increasing inflationary expectations will shift the ZZ curve upwards, and vice versa. Figure 6 shows the case of a given positive rate of inflationary expectations. A Phillips-curve-type inverse relationship between the steady-state rates of inflation and unemployment will exist in the north-east Cartesian quadrant if there exist positive inflationary expectations. Generalising further, we see that equation (43) implies that

$$u_T \gtreqless 0 \quad \text{as} \quad \pi_T \gtreqless \hat{P}_e \tag{47}$$

Our analysis here not only confirms and is in full accordance with the main conclusions of the so-called "microeconomic foundations of unemployment and inflation theory" (16), but it is also consistent with what many economists think to be the case in recent years: that aggregate demand-management policies, fiscal and/or monetary, may be successful in reducing the rate of unemployment by increasing the rate of inflation (the trade-off hypothesis) only as long as the actual rate of inflation is not fully anticipated (the accel-

erationist hypothesis). Again, it must be emphasised that these conclusions were arrived at on the basis of a relatively simple non-Walrasian theoretical framework.

We have so far worked with the assumption that inflationary expectations are exogenously determined, and a model based on their presumed erratic changes may not be altogether without some empirical basis. Many economists do believe, however, that expectations are endogenously determined, reacting to what happens in the economy in a "learning-by-failing" manner. The usual assumption of adaptive expectations attempts to capture this aspect, and we here introduce such adaptive mechanisms before we conclude our discussion.

Starting from the generalised money-wage dynamics equation

$$\hat{W} = \beta \cdot E_N(\varepsilon, v) + \hat{P}_e \qquad (48)$$

we now postulate that

$$\frac{d\hat{P}_e}{dt} = \lambda(\hat{W} - \hat{P}_e) \qquad (49)$$

Equation (48) says that the workers will change their expected rate of inflation depending on whether or not the actual rate of money-wage in-

creases failed to satisfy their previous expectations about price increases. The constant λ is a coefficient of adjustment, reflecting the speed of "learning". Solving equation (49) for $\hat{P}_e$ and substituting into (48) we get an expression implying the following expectations model:

$$\hat{P}_e = \varphi(\varepsilon, v) \text{ with } \varphi_1 > 0, \varphi_2 < 0 \qquad (50)$$

Following a similar analytical strategy, we amend the generalised price-dynamics equation

$$\hat{P} = \alpha \cdot E_Q (\varepsilon, v) + \hat{W}_e \qquad (51)$$

by postulating that

$$\frac{d\hat{W}_e}{dt} = \mu(\hat{P} - \hat{W}_e) \qquad (52)$$

In this case, the firms will revise their expected rate of money-wage increases depending on whether or not the actual rate of price increases matched their previously expected cost increasing rate of money-wage rises. Again, μ is a constant coefficient of adaptation. Solving equation (52) for $\hat{W}_e$ and substituting into (51) we get an expression implying the following expectations model:

$$\hat{W}_e = f(\varepsilon, v) \text{ with } f_1 > 0, \quad f_2 = 0 \qquad (53)$$

Using equations (50) and (53) we can expand the dynamic mechanisms (48) and (51) into

$$\hat{P} = \alpha[i(\varepsilon;m) - s(\varepsilon)] + f(\varepsilon,v) \qquad (54)$$

$$\hat{W} = j_1(\varepsilon) + j_2(v) + \varphi(\varepsilon,v) \qquad (55)$$

In this case, the two fundamental differential equations of our LR analysis are

$$\hat{\varepsilon} = A\{\alpha[i(\varepsilon;m) - s(\varepsilon)] + f(\varepsilon,v) - j_1(\varepsilon) - j_2(v) - \varphi(\varepsilon,v)\} = \Psi(\varepsilon,v) \qquad (56)$$

$$\hat{v} = n - G(\varepsilon;m) = X(\varepsilon,v) \qquad (57)$$

The steady-state is again defined at $\hat{\varepsilon} = \hat{v} = 0$, and the LR equilibrium thus attained will be locally stable if the following stability conditions hold:

$$A[f_2 - j_2'(v) - \varphi_2] \cdot G'(\varepsilon) > 0 \qquad (58)$$

and

$$\alpha[i'(\varepsilon) - s'(\varepsilon)] - j_1'(\varepsilon) + (f_1 - \varphi_1) < 0 \qquad (59)$$

Stability condition (58) is obviously satisfied, while for condition (59) we can make the following statement: if the steady-state LR equilibrium satisfied the stability conditions (34), in the absence

of adaptive expectations, the presence of adaptive expectations will not destroy this stability if

$$f_1 \leqq \varphi_1 \qquad (60)$$

Interpreted as a stability condition, equation (60) implies a differential behaviour in the adaptiveness of the firms' and the workers' expectations, and in particular it requires that the firms do not adapt (change) their expectations faster than the workers. In view of the fact that in our framework it is the expectations of the workers which characterise the nature of the steady-state (as it was shown in the previous section), our results here are not surprising: it is a fast adjustment in the workers' adaptive expectations that will guarantee the stability (and therefore the attainment) of a steady-state LR equilibrium.

It remains to examine the nature of the steady-state equilibrium in this case. When this LR equilibrium has been attained, the adaptive expectations mechanisms will be fully worked out. Thus

$$\frac{d\hat{P}_e}{dt} = 0 \quad \text{or} \quad \hat{P}_e = \hat{W} = \pi_T \qquad (61)$$

and

$$\frac{d\hat{W}_e}{dt} = 0 \quad \text{or} \quad \hat{W}_e = \hat{P} = \pi_T \qquad (62)$$

Equations (61) and (62) imply that, at the steady-state,

$$f(\varepsilon,v) = \varphi(\varepsilon,v) = \pi_T$$

It follows that the LR equilibrium will be characterised by

$$\alpha \cdot E_Q + \pi_T = \beta \cdot E_N + \pi_T = \pi_T \qquad (63)$$

The implication of equation (63) is that

$$\alpha \cdot E_Q + \pi_T = \pi_T \quad \text{thus} \quad E_Q = 0 \qquad (64)$$

and

$$\beta \cdot E_N + \pi_T = \pi_T \quad \text{thus} \quad E_N = 0 \qquad (65)$$

As the above two expressions hold for any value of π_T, positive, negative or zero, the following general result holds:

$$u_T = 0 \quad \text{for any} \quad \pi_T \gtreqless 0 \qquad (66)$$

When expectations have fully adjusted to the actual steady-state rate of inflation, that is when π_T is fully anticipated, the steady-state rate of unemployment is independent of the rate of inflation, and it is always zero. The interpretation of such a "zero natural rate of unemployment" conclusion was previously explained on the basis of our non-Walrasian theoretical framework.

5. CONCLUDING REMARKS

The definitive treatise of disequilibrium macroeconomics, or the economics of disorder, has yet to be written. This is not just a matter of making the mathematical models more comprehensive, by including, say, the financial and the external sector of the economy, since this has already been done or is being done. The remaining problems, and there are many, have to do mainly with the following matters:

First, what are the market or non-market (institutional or contractual) arrangements within any particular economy that are co-responsible, with the "dual decision hypothesis" process, for the existence of macroeconomic disequilibrium. To list just two examples: to what extent are the contracted money-wage rigidities in collective bargaining situations able to account for the magnitudes of labour lay-offs during a recession; to what extent is domestic economic disorder due to disturbances coming from the international interdependence, and from the instability of the world markets for commodities and raw materials.

Second, how are expectations formulated, and

how can they be conditioned in order to become a stabilising rather a destabilising factor. For example, some recent attempts to construct models where expectations are formed "rationally" in a stable stochastic environment are aimed at this important problem.

Third, what are the policy implications of the disequilibrium approach to macroeconomics. To mention two examples: are monetary and fiscal policies, with all their feedback effects taken into consideration, an appropriate and efficient tool of stabilisation policy, or should the authorities re-direct their attention to industry-specific and market-specific micro-economic policy measures; is an income-policy, or a wages-prices-profit policy of the "social contract or compact" type a viable perspective, if the test of its success lies in stabilising claims on the total income and stabilising expectations by making them mutually consistent. As we are only as of late progressively more aware of the dimensions of contemporary economic problems, the "new" macroeconomics needs a lot of additional theoretical and empirical work before it can be presented as a comprehensive and self-contained body of doctrine. Along its numerous extensions, such work is currently being carried out. For the moment, our only solid contribution lies in exposing the methodological requirements for this approach,

and the recognition that some important phenomena of disorder can, in principle, be accounted for by a generalised macroeconomic theory.

At the conclusion of this essay, I feel it is appropriate to use the eloquent dramatisation of our theme in the words of one of the most eminent economists of our time, Nicholas Georgescu-Roegen: "Many still share the idea that the Walrasian system would be an accurate calculating device for a Laplacean demon. . . this logic ignores a most crucial phenomenon: the very fact that an individual who comes to experience a new economic situation may alter his preferences. *Ex post* he may discover that the answer he gave to our demon was not right. The equilibrium computed by our demon is thus immediately defeated not by the intervention of an exogenous factor but by endogenous causes. Consequently, our demon will have to keep on computing running-away equilibria, unless by chance he possesses a divine mind capable of writing the whole history of the world before it actually happens. . . One additional difficulty into which our demon would certainly run with the Walrasian system. It is the Oedipus effect, which boils down to this: the announcement of an action to be taken changes the evidence upon which each individual bases his expectations and, hence, causes him to reverse his previous plans" [(5), pp. 334-335].

FIGURE 1

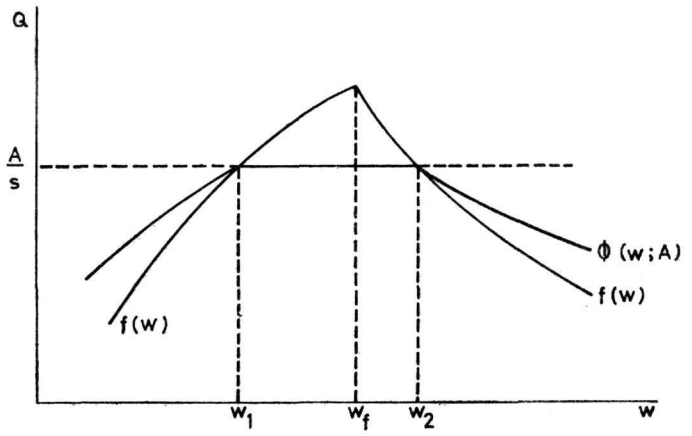


FIGURE 2

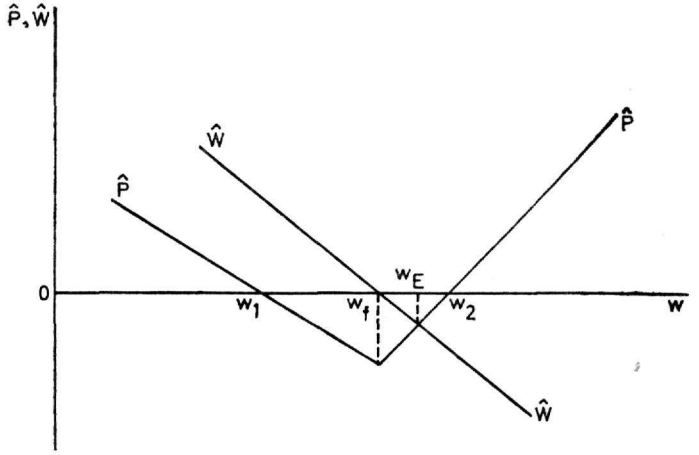


FIGURE 3

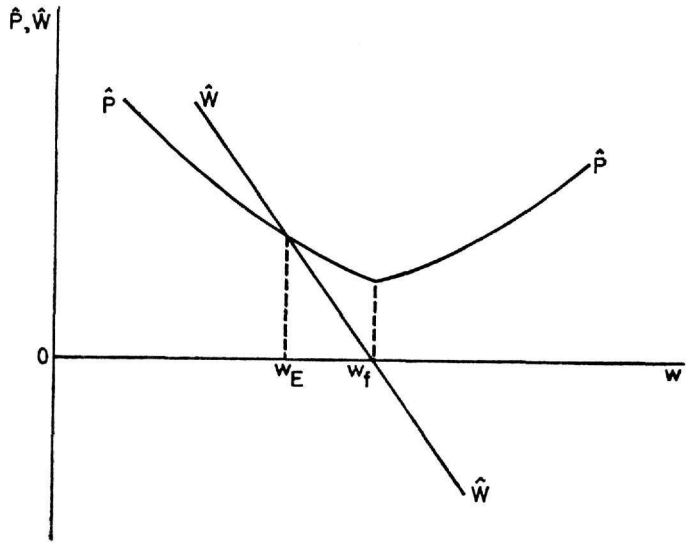


FIGURE 4

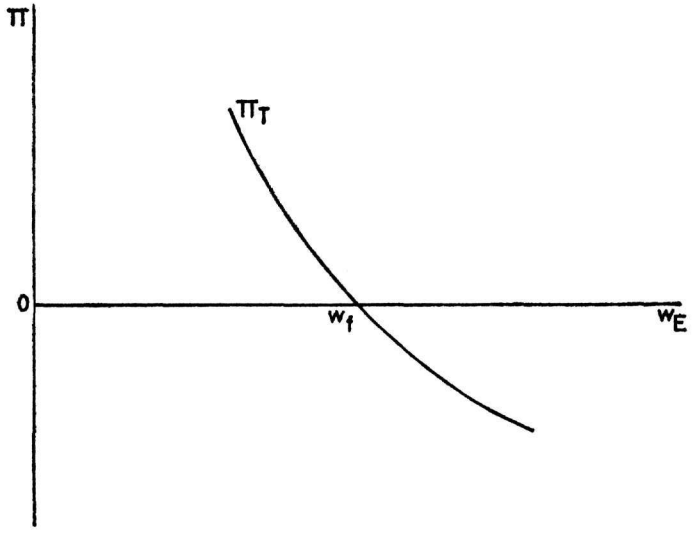


FIGURE 5

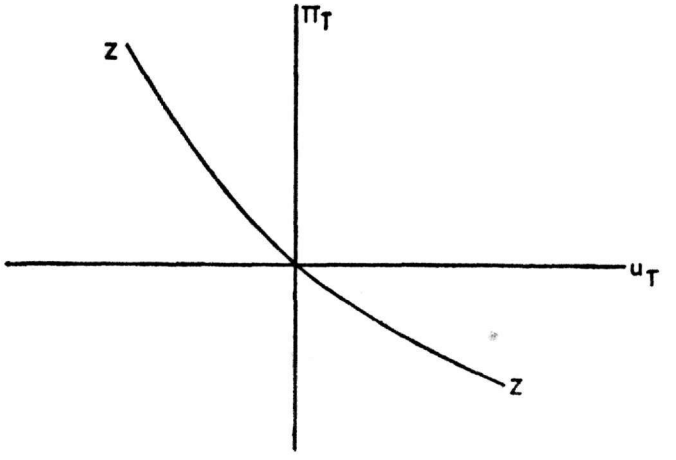
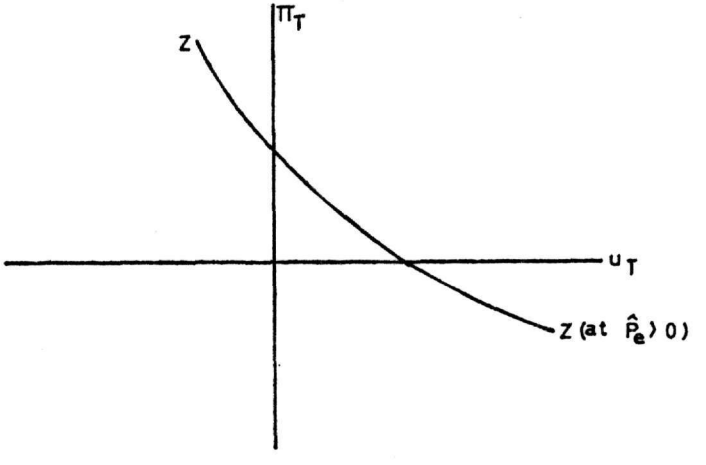


FIGURE 6



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